

[72] Inventors **Rostislav Sergeevich Kuznestsov**
ulitsa Scherbakakovskaya, 40/42, kv. 195;
Alexandr Grigorievich Uskach, ulitsa
Oktyabrskaya, 49, kv. 63; Vladimir
Grigorievich Kostikov, ulitsa
Davydkovskaya, 10, kv. 104, all of Moscow,
U.S.S.R.

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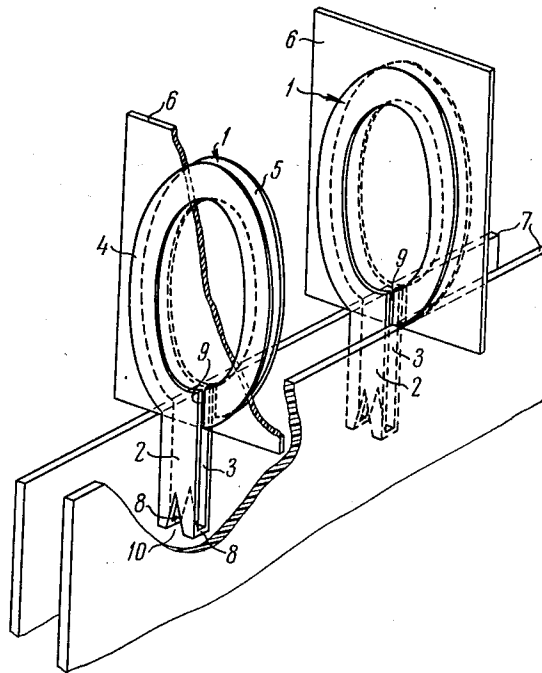
Primary Examiner—Robert S. Macon
Attorney—Waters, Roditi, Schwartz & Nissen

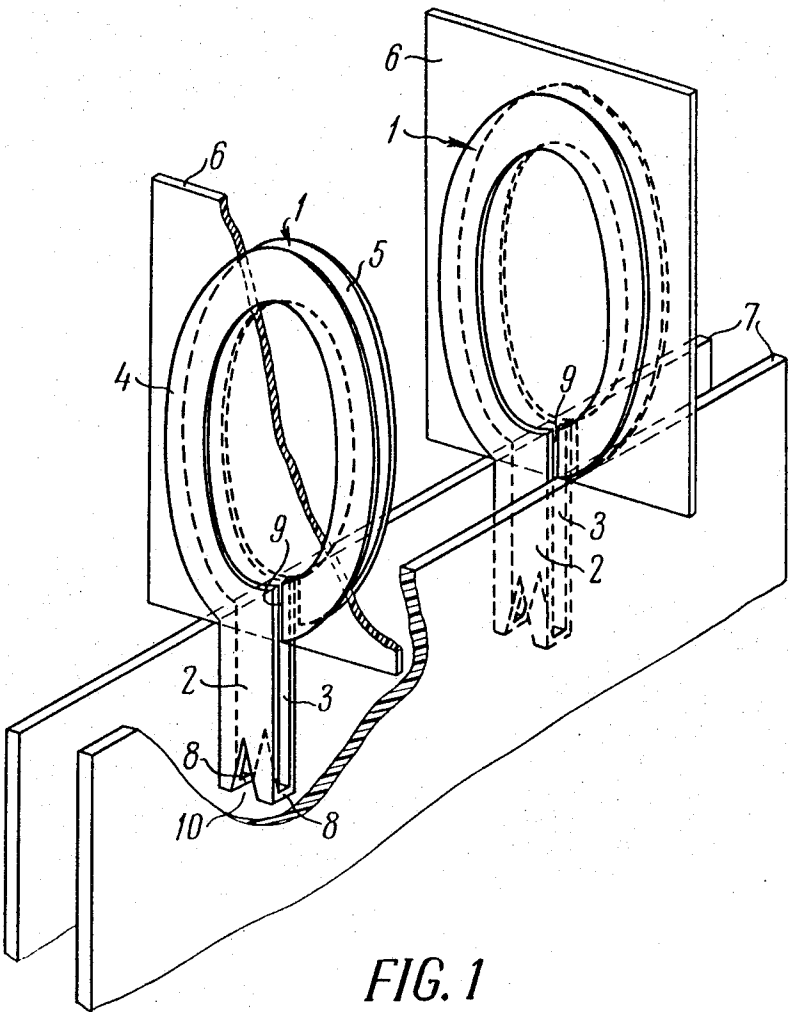
[54] **ARC-QUENCHING CHAMBER**
6 Claims, 12 Drawing Figs.

[52] U.S. Cl..... **200/144 R,**
200/147 B
 [51] Int. Cl..... **H01h 33/08**
 [50] Field of Search..... **200/147,**
147 B, 144

ABSTRACT: The present invention relates to electric switching devices, and more specifically to the arc-quenching chambers of such devices.

There is an arc-quenching chamber comprising a de-ion grid composed of spaced plates joined at one end with two straight portions and two helically bent portions lying in parallel planes; forming an airgap between the initial and end of the bent portions, through which any base point of a minor electric arc passes, the airgap being maintained at a minimum.





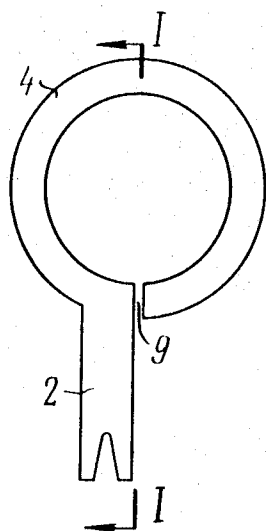


FIG. 2

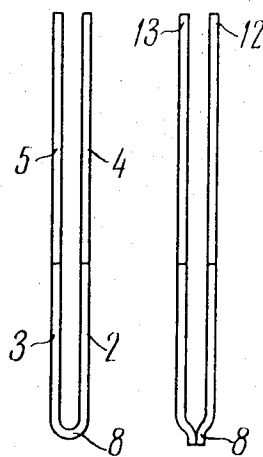


FIG. 3

FIG. 12

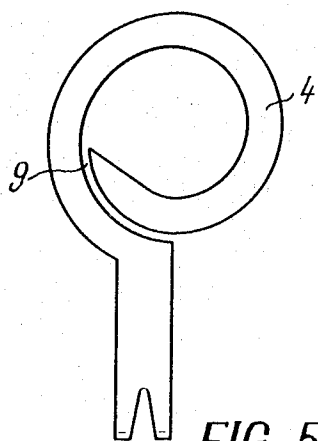


FIG. 5

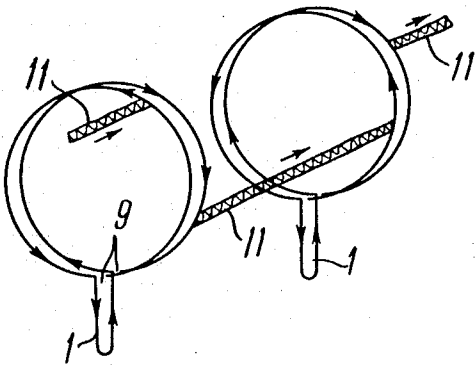


FIG. 4

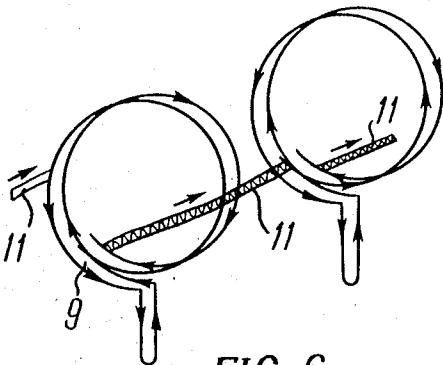


FIG. 6

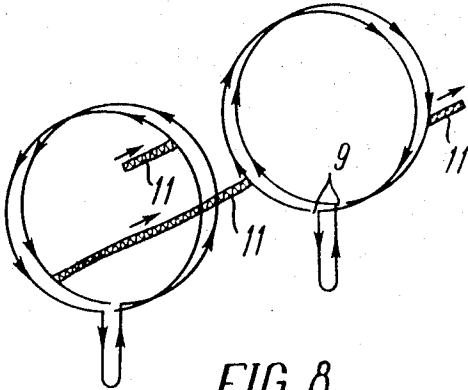


FIG. 8

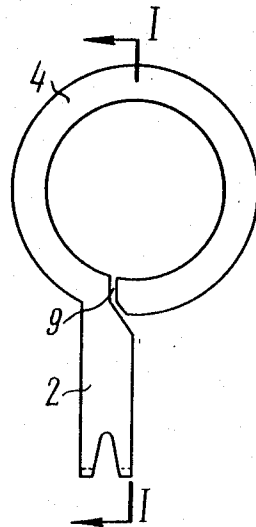


FIG. 9

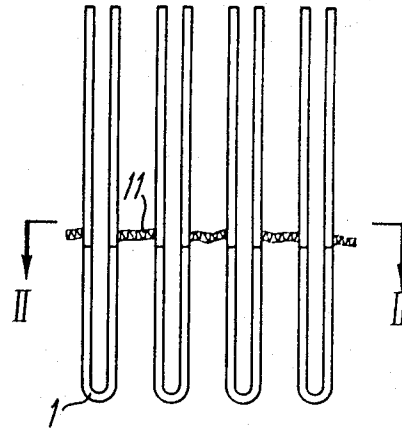


FIG. 10

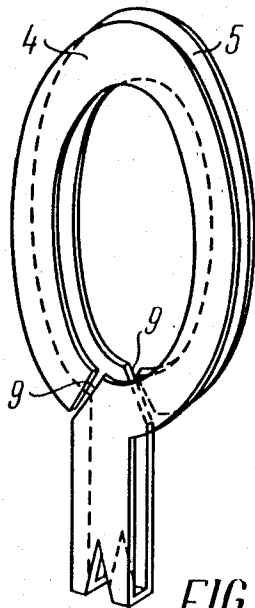


FIG. 7

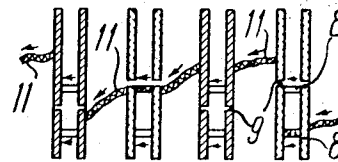


FIG. 11

ARC-QUENCHING CHAMBER

The present invention relates to electric switching devices, and more specifically to the arc-quenching chambers of such devices, comprising metal de-ion plates.

There exist arc-quenching chambers incorporating spaced metal plates which make up a de-ion grid, wherein the plates are joined at a neck which extends into two straight portions lying in parallel planes.

Among the disadvantages of such arc-quenching chambers are that the arc may flash over the plates as it emerges from the grid; the plates and walls of the chamber are subject to excessive wear at the ends of the plates; there is a large quantity of hot gases and flame expelled from the chamber over a large distance; and the device is large in size.

It is an object of the present invention to eliminate the above-mentioned disadvantages.

A specific object of the invention is to produce an arc-quenching chamber of reduced size, reduced wear on the plates and shields of the chamber, with eliminated flashover across the arc-splitting plates of the de-ion grid, and simplified design owing to the changed shape of the metal plates.

This object is accomplished by the invention which provides an arc-quenching chamber comprising a de-ion grid composed of a pair of spaced plates joined at one end to form a neck which extends into two straight portions lying in parallel planes, the straight portions of the plates, according to the invention, extending or curving at their free ends along a helix within the parallel planes, so that the airgap between the start and finish of the bent portion of the plate, through which the base point of the minor arc passes, is kept to minimum.

The ends of the plates may be bent along a helix either in the same or opposite directions.

It is preferable to offset the airgaps of the plates through which the base points of the minor arcs pass relative to one another.

The design of the arc-quenching chamber disclosed herein provides for a more reliable and longer operation of the chamber over a wide range of switched currents as compared with existing chambers of this type. It is simple to fabricate and compact in layout.

The reliable and long operation of the chamber is secured by the fact that the arc is caused repeatedly to circulate in the closed space of the chamber, so that the size of the chamber is reduced, electric wear and expulsion of flame from the chamber are cut down, and arc flashover is eliminated.

The chamber disclosed herein may be used in DC and AC circuit breakers. It may also be successfully employed in contactors and other switching devices.

The invention will be best understood from the following description of a preferred embodiment, when read in connection with the accompanying drawing wherein:

FIG. 1 shows an arc-quenching chamber, fully assembled, according to the invention;

FIG. 2 shows a metal plate with the ends lying in parallel planes, bent in the same direction, according to the invention;

FIG. 3 shows the side elevation of the plate of FIG. 2, according to the invention;

FIG. 4 shows the current loops in a de-ion grid consisting of the plates of FIG. 2, according to the invention;

FIG. 5 shows a metal plate with portions bent along a helix, according to the invention;

FIG. 6 shows the current loops in a de-ion grid consisting of the plates of FIG. 5, according to the invention;

FIG. 7 shows a metal plate with the ends lying in parallel planes 4, bent along a helix in opposite direction, according to the invention;

FIG. 8 shows the current loops in a de-ion grid consisting of the plates of FIG. 7, according to the invention;

FIG. 9 shows a metal plate with the airgap offset relative to the airgap in the plate of FIG. 2, according to the invention;

FIG. 10 shows the side elevation of a de-ion grid consisting of the alternating plates of FIGS. 2 and 9, according to the invention;

FIG. 11 shows a cross-sectional view through a de-ion grid with offset airgaps between the plates and the minor arcs in the grid, according to the invention;

FIG. 12 shows the side elevation of a metal plate fabricated from two separate elements by welding or any other method, according to the invention.

Referring to FIGS. 1, 2, and 3, there is disclosed an arc-quenching chamber comprising a de-ion grid composed of spaced de-ion plates 1 joined at one end with straight portions 2 and 3, bent portions 4 and 5 lying in parallel planes, and insulating barriers 6 placed between the portions 4 and 5 of the plates 1. The plates 1 and the barriers 6 are fastened in the walls (shields) 7 of the chamber.

For simplicity, FIG. 1 shows only two plates, the remaining plates being fabricated in a similar manner. The drawing also omits mounting hardware and some structural elements, since they are of no fundamental importance.

At the entrance of the arc to the chamber, the straight portions 2 and 3 are joined together by current-conducting necks 8 to form a generally V-shaped or U-shaped juncture, the straight portions extend into the portions 4 and 5 which are curved along a helix or circle and which lie in the same plane respectively with the portions 2 and 3. The airgap 9, as is shown in FIG. 1, between the start and finish of the bent portion 4, 5 is maintained at a minimum.

The portions 2 and 3 have a dove-tail 10 in the lower part.

The plates 1 should preferably be fabricated from a ferromagnetic material.

The electric arc striking between the contacts of the switching device, not shown in the drawings, is expelled between the shields 7 towards the dove-tails 10 of the de-ion grid by the action of the magnetic field.

After it comes in contact with the plates, the electric arc establishes base points in the airgaps between the surface 2 and 3 and is thus split into smaller arcs 11 (FIG. 4).

The current, flowing in series in the smaller arcs 11 and in the plates 1, forms V- and pi-shaped loops which are shown diagrammatically in FIG. 4, where the arrows show the direction of the current in these loops.

In response to the interaction between the magnetic fluxes established by the currents flowing in the plates and in the smaller arcs, the latter shift their base points along the surface of the portions 2, 3, and 4, 5 towards the airgaps 9. Moving on, the minor arcs 11 span the gaps 9 and establish new base points, now at the ends of the portions 2 and 3.

As this happens, the minor arcs circulate on the surface of the portions 4 and 5 until the arc goes out.

It should be noted that the plates fabricated from a ferromagnetic material as described above facilitate the passage of the minor arcs across the gaps 9 and the formation of base points at the entrance of the arc to the grid.

FIG. 5 shows the plates 1 with the portions 4 and 5 bent along a helix so that the start and finish of these portion overlap.

FIG. 6 shows the current loop in the arcs 11 and in the plates of FIG. 5, where the arrows show the current paths. With this embodiment of the plates, the magnetic field near the gaps 9 is augmented, which fact speeds up the transfer of the base points of the arc across them and minimizes the fusion of the plate surfaces.

FIG. 7 shows the plates 1 with the portions 4 and 5 bent in opposite directions and lying in parallel planes. In such plates, the currents in the portions 4 and 5 are in the same direction, as shown in FIG. 8, which fact augments the own magnetic field of the loop and, as a consequence, enhances the quenching of the arc.

The airgaps 9 in the plates 1, fabricated as shown in FIG. 2, may be offset relative to the vertical axis I-I (FIG. 9).

In a de-ion grid (FIG. 10) composed of alternating plates 1 of FIGS. 2 and 9, the airgaps 9 are offset relative to one another. The base points of the minor arcs 11 (FIG. 11) are now offset relative to one another as they approach the gaps 9 owing to the fact that the latter are offset too. The offset

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between the adjacent gaps 9 in the slot of each minor arc produces a pi-shaped current loop with a peaked top, which fact augments the own magnetic field and minimizes the fusion of the plate surfaces.

It is preferred to fabricate spaced plates 1 (FIG. 12) from two separate elements 12 and 13, each of which may be fabricated as shown in FIGS. 2, 5, and 9.

The elements 12 and 13 may be joined together at the neck 8 by welding or any other method securing electric conduction through the neck.

The plates 1 fabricated from two separate elements are more convenient to manufacture, since this eliminates the use of dies and punches and cuts down the waste of the source material.

What is claimed is:

1. An electric arc-quenching chamber comprising, a de-ion grid formed of a pair of generally parallel plates, said plates being joined at one end so as to provide a closed neck portion, the free ends of said plates extending into a helix portion within said parallel planes, an airgap being formed between said parallel plates whereby a minor electric arc establishes base points in said airgap between said plates, and a further airgap being formed between the initial and end points of the

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helix portions of said plates through which the arc base points pass, said further airgap being maintained at a minimum dimension.

2. A chamber as claimed in claim 1, wherein the free ends of each of said parallel plates form a helix extending in the same direction.

3. A chamber as claimed in claim 1, wherein the free end of each of said parallel plates forms a helix extending in opposite directions to each other.

4. A chamber as claimed in claim 1, wherein the air gaps formed between the initial and end points of each of said helix portions through which the arc base points pass are offset relative to each other in said grid.

5. A chamber as claimed in claim 2, wherein the airgaps formed between the initial and end points of each of said helix portions through which the arc base points pass are offset relative to each other in said grid.

6. A chamber as claimed in claim 3, wherein the airgaps formed between the initial and end points of each of said helix portions through which the arc base points pass are offset relative to each other in said grid.

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